GPCP V3.2 Release Notes

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Changes from Version 2 to Version 3

The algorithm for the Global Precipitation Climatology Project (GPCP) is being upgraded from Version 2 to Version 3 under projects funded by the NASA Making Earth Science Data Records for Use in Research Environments (MEaSUREs) program.

Major changes in the Monthly product include:

- Add Upgrade geosynchronous infrared (GEO-IR) brightness temperature datasets, including expansion from the latitude band 40°N-S to 60°N-S, and shifting to a consistent-format record through the entire record. The latter required shifting the start-of-record date from January 1979 to January 1983.
- Add Upgrade algorithms for passive microwave (PMW) data (still only used for month-to-month calibration) and GEO-IR data.
- Add Shift from 2.5° to 0.5° lat./long. gridding.
- Add calibration by climatologies based on combinations of shorter-record, advanced sensors, including CloudSat, Global Precipitation Measurement (GPM) mission, and Tropical Rainfall Measuring Mission (TRMM).

Major changes in the Daily product include:

- Replace the geo-IR-based Threshold-Matched Precipitation Index (TMPI) with IMERG estimates, with coverage expanded from 40° N-S to 58° N-S.
- Use a consistent AIRS-IR record.
- Shift from calibration of AIRS-to-TOVS to improved TOVS-to-AIRS-IR.
- Apply modern Merged CloudSat, TRMM, and GPM (MCTG; Behrangi and Song 2020) climatological calibrator to TOVS/AIRS.

The probability of liquid phase data field was added to both the Monthly and Daily data files in Version 3. This classification includes both solid and mixed solid-and-liquid since the latter is rare and tends to melt and enter the hydrological cycle immediately. The Sims and Liu (2015) specification was adapted to compute probabilities at individual times in both data sets, driven by surface pressure, 2-meter temperature, and 2-meter specific humidity. For the Monthly dataset, Modern-Era Retrospective Analysis for Research and Applications, Version 2 (MERRA-2; Gelaro et al. 2017) ancillary data were used to compute individual probabilities for 3-hourly PERSIANN-CDR data, then averaged for the month with weighting by the precipitation rate. As such, the

probability field is set to missing outside the latitude band 60°N-S. For the Daily dataset, the same process is followed, except the individual maps of probability are taken from the globally complete Integrated Multi-satellitE Retrievals for the Global Precipitation Measurement (GPM) mission (IMERG) Final Run (Huffman et al. 2020), which uses ancillary data provided by European Centre for Medium-Range Weather Forecasting (ECMWF) Reanalysis 5 (ERA5; Hersbach et al. 2020). [This is for Version 3.2; ERA-Interim was used in Version 3.1.] In both the Monthly and Daily, zero-precipitation grid boxes are given a straight average of the probabilities.

Because the GPCP datasets are heavily used in the global research and application communities, we recognize that the significant changes that Version 3 entails require careful characterization before users can be expected to shift away from Version 2. As such, we consider the Version 2.3 to be the dataset of record for general use while Version 3.2 is examined, and likely upgraded in response to these studies.

Several figures and tables are included below showing the climatological differences between Versions 2.3 and 3.2. A brief introduction is provided in Adler et al. (2022) and a more complete description of V3.2 and detailed comparisons with V2.3 will be included in Huffman et al. (2022).

Changes from Version 3.1 to Version 3.2

Within Version 3, the Monthly and Daily Satellite-Gauge products have now been upgraded to Version 3.2, and the previous Version 3.1 is considered obsolete.

Evaluation of Monthly GPCP V3.1 by the development team and beta users showed larger than expected inter-annual variation in precipitation rate during both the Special Sensor Microwave Imager (SSMI) and Special Sensor Microwave Imager/Sounder (SSMIS) epochs, particularly in the tropical oceans. This was traced back to the Goddar Profiling algorithm (GPROF; Kummerow et al. 1996, Olson et al. 1999, Kummerow et al. 2001) precipitation estimates from SSMI and SSMIS. To mitigate this, the development team calibrates the Monthly GPROF-adjusted Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks Climate Data Record (PERSIANN-CDR; Ashouri et al., 2015) estimates to the monthly Microwave Emission brightness Temperature Histogram (METH; Chiu and Chokngamwong 2010) estimates (employed in Version 2), essentially downscaling the monthly 2.5°x2.5° METH to the 0.5°x0.5° resolution for the latitude band 25°N-S. This adjustment is tapered to no METH adjustment at 45°N and S. Although METH is only available over ocean, the gauge analysis tends to dominate over land, so the exact performance of GPROF over land is not considered critical.

Analysis using Gravity Recovery and Climate Experiment (GRACE) data showed that the Fuchs et al. (2001) gauge undercatch correction better matches water balance information than the Legates and Willmott (1990) correction for Eurasia north of 45°N (Behrangi et al. 2018, 2019) where the totals are generally reduced. Accordingly, the undercatch correction uses Fuchs in that region, with a linear taper across 45-50°N from Legates-Willmott to Fuchs. This change has the greatest impact in the Winter, when snowfall drives larger undercatch corrections.

For both the Monthly and Daily, the variable name for the probability that the precipitation at the surface is in the liquid phase has been changed from Probability of Liquid Phase Precipitation in V3.1 to Probability of Liquid Phase in V3.2.

Changes in the precipitation estimates from the previous V3.1 Daily to the current V3.2 Daily are solely the result of changes from the GPCP V3.1 Monthly to the GPCP V3.2 Monthly.

The Monthly and Daily product periods of record are currently 1983-2020 and 2001-2020, respectively, both at 0.5°x0.5° resolution.

Access Information

Data are available from the Goddard Earth Sciences Data and Information Services Center (GES DISC) at *https://disc.gsfc.nasa.gov*. The complete naming convention can be found in the GPCPV3.2 README documents. Downloading data from GES DISC requires an Earthdata account, for which registration is free and easy (see *https://disc.gsfc.nasa.gov/data-access*).

Additional Notes

In the future, GPCP expects to release upgrades to the Monthly and Daily SG products, and to develop and release (globally complete) 3-hourly products.

Key GPCPV3.2 Documents

The ATBD and README documents (and the data) are accessible on the respective landing pages for the Monthly and Daily products:

https://disc.gsfc.nasa.gov/datasets/GPCPMON_3.2/summary
https://disc.gsfc.nasa.gov/datasets/GPCPDAY_3.2/summary

Introductory article manuscript

Adler, R.F., A. Behrangi, G.J. Huffman, D.T. Bolvin, E.J. Nelkin, G. Gu, 2022: New Version 3.2 GPCP Monthly Global Precipitation Analysis Released. GEWEX Quarterly, in preparation.

Journal manuscript

Huffman, G.J., A. Behrangi, R.F. Adler, D.T. Bolvin, E.J. Nelkin, G. Gu, 2022: Introduction to the New Version 3 GPCP Monthly Global Precipitation Analysis, in preparation.

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First Validation Results

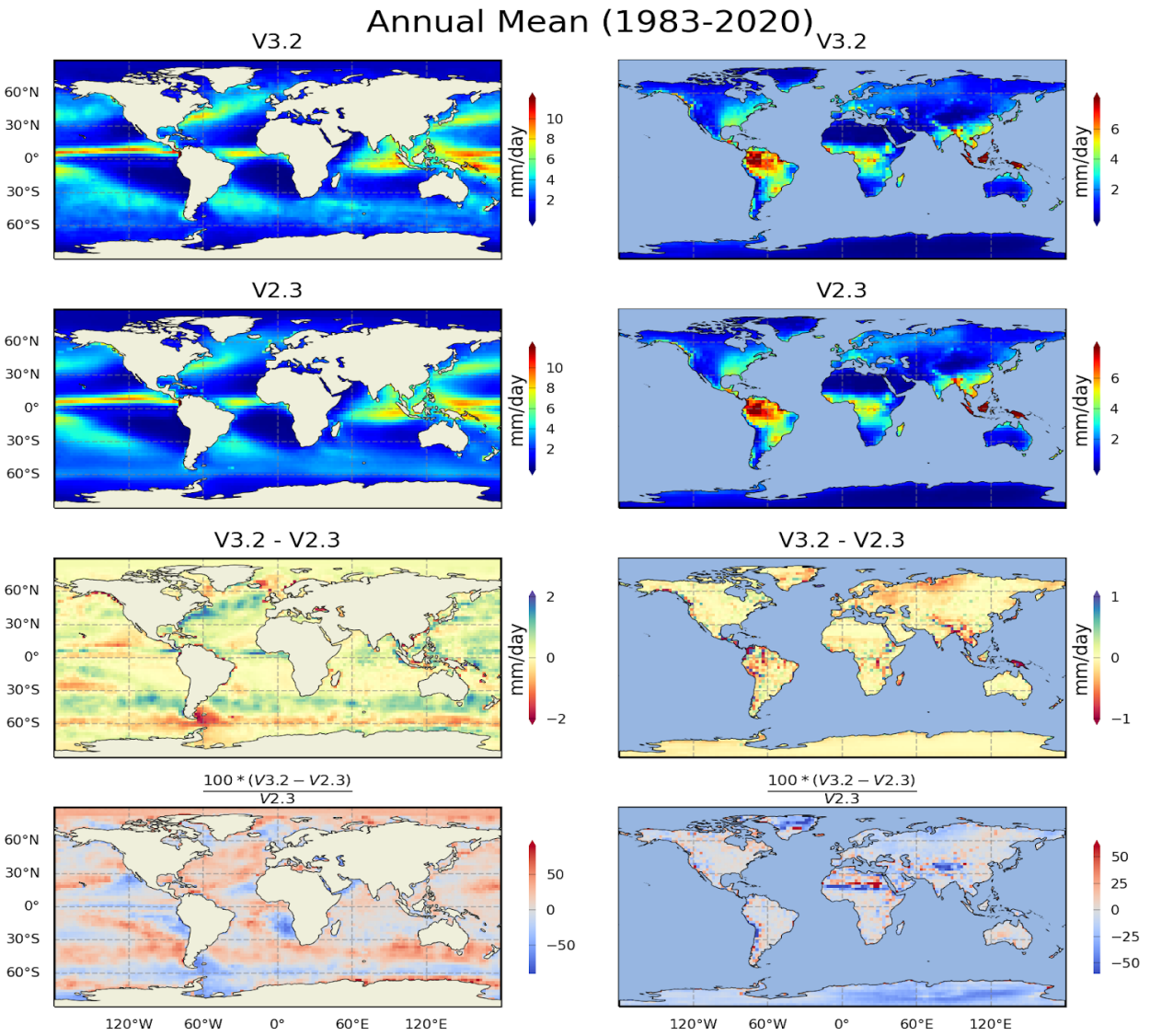

Fig. 1. Maps of annual mean precipitation estimates for 1983-2020 using V2.3 and V3.2, separately over ocean (left column) and land (right column) and their differences

Comparing V3.2 to the "operational" V2.3 climatology, averaged from the native 0.5° to the V2.3 2.5º resolution:

- V3.2 tends to be higher over oceans;
- largest increases are in storm tracks;
- decrease around 60ºS in V3.2 improves a perceived V2.3 issue;
- increase in polar regions is driven by CloudSat (through MCTG climatological scaling);
- gauges tend to dominate land areas in both V2.3 and V3.2; and
- substituting the Fuchs gauge undercatch correction in V3.2 (Northern Eurasia poleward of 45ºN) reduces precipitation. This is emphasized in the boreal Winter (Fig. 2).

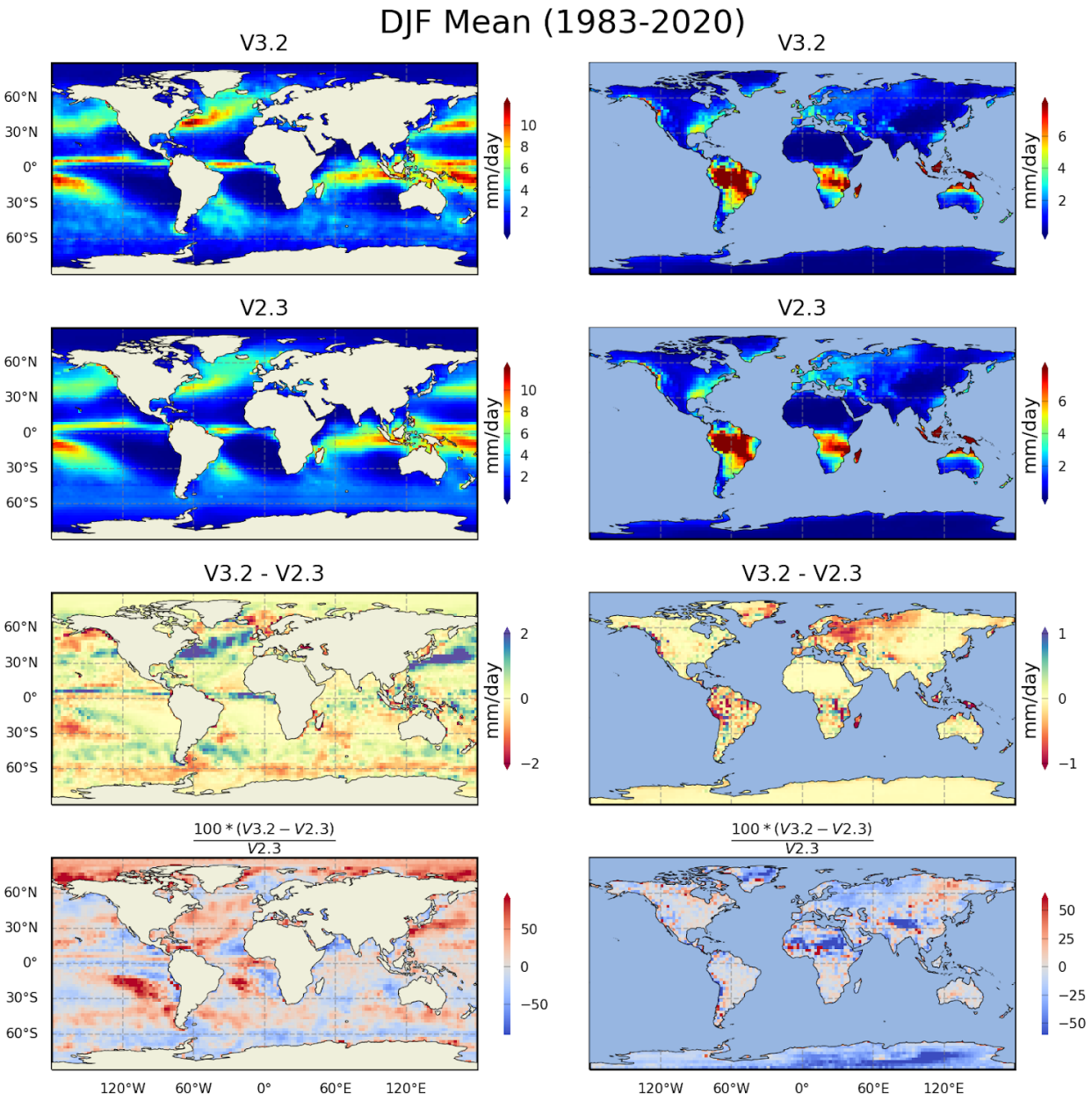

Fig. 2. As in Fig. 1 but for boreal Winter.

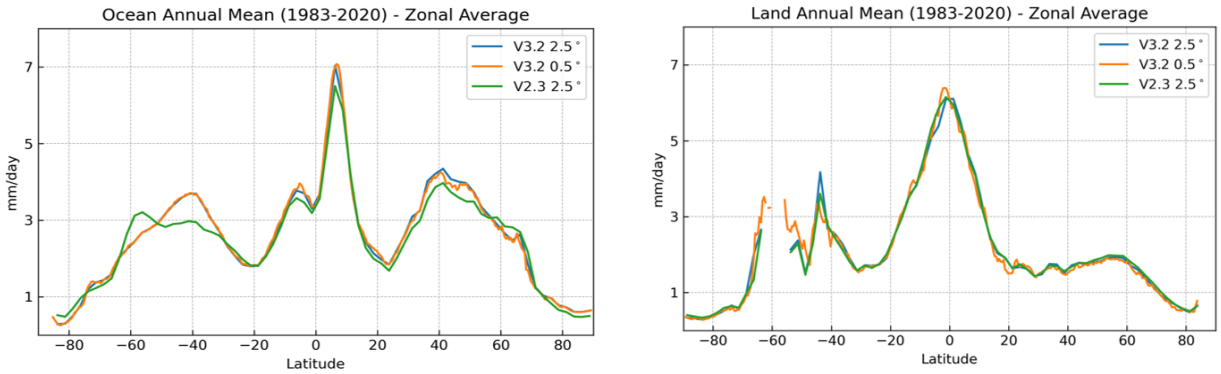

Figure 3. Zonal average of precipitation rates and comparison of V2.3 with V3.2, separately over ocean (left) and land (right). The differences around 40-60°S are considered an improvement. The land profiles are fairly consistent because gauge dominates.

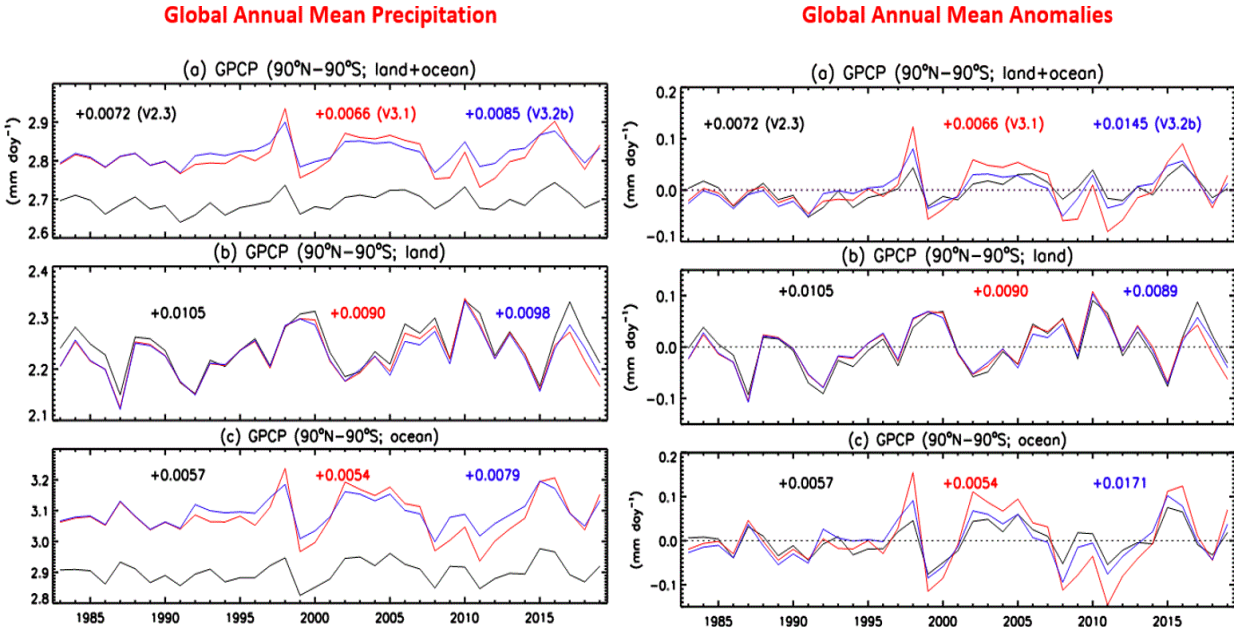

Fig. 4. Comparison of annual mean, trends, and variations among GPCP V2.3 (black), V3.1 (red), and V3.2 (blue). Climatological calibration by TCC and MCTG increase the V3 means, while METH calibration reduces the V3.2 interannual changes compared to V3.1.

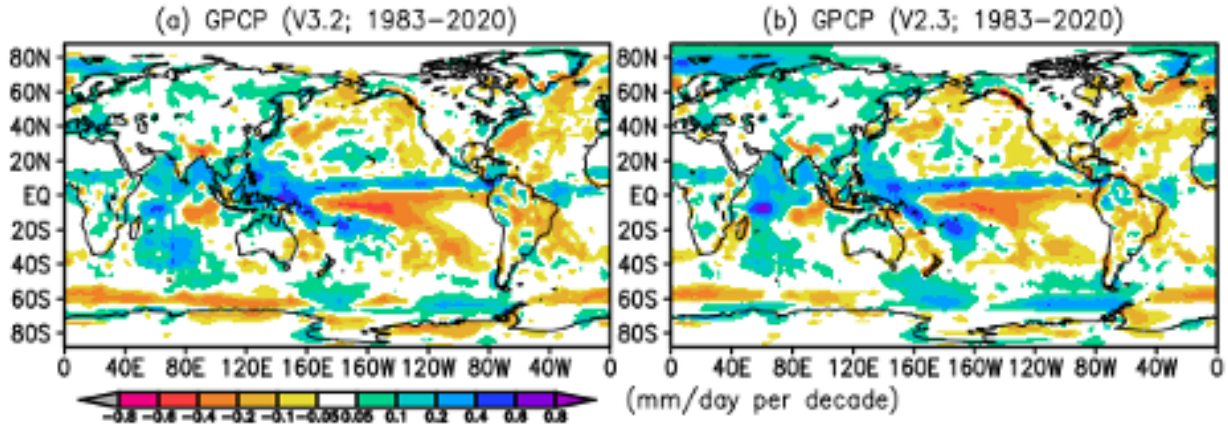

Fig. 5. Maps of regional trends for GPCP V2.3 and V3.2. The patterns tend to be similar, but with some changes in amplitude.

Table 1. Comparison of mean precipitation rate (mm/day) for V3.2 and V2.3 (1983-2020). Surface area weighting is included. The increases over ocean roughly correspond to recommendations from previous studies and result from the TCC and MCTG climatological weighting. Land is little changed due to dominance by the gauge analysis.

	Ocean			Land			Global		
GPCP	**V3.2**	**V2.3**	**% change compared to V2.3**	**V3.2**	**V2.3**	**% change compared to V2.3**	**V3.2**	**V2.3**	**% change compared to V2.3**
25°N-25°S	3.35	3.17	5.68	3.45	3.47	-0.58	3.38	3.25	4.00
60°N-60°S	3.26	3.05	6.89	2.52	2.54	-0.79	3.05	2.90	5.17
90°N-90°S	3.09	2.90	6.55	2.21	2.24	-1.34	2.81	2.69	4.46

Graphics for the Daily dataset are being developed.